Integrated analysis of water quantity and quality in the Havel river basin

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Project "Management in the Havel River Basin"
funded by BMBF

The work presented here was done within the project "Water resources management in the Havel River basin" founded by the German Federal Ministry of Education and Research. The goal is the implementation of the **European Water Framework Directive** in general, and the improvement of water quality in the Havel River, one of the largest tributaries of the Elbe River, in particular. Within that scope the project will develop a methodology for solving some of the most important water-related problems in the basin. More information can be found on the website: *http://www.havelmangement.de.*

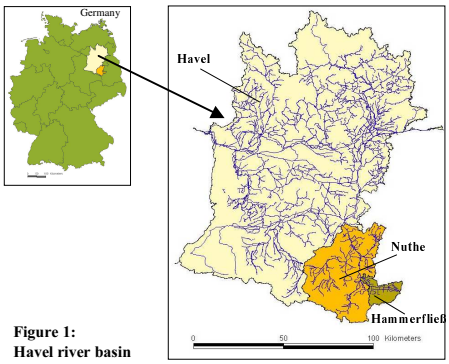

Figure 1: Havel river basin

Study region (Fig. 1)

Large scale: Havel

Area: 13884 km²
Land use: agriculture 43 %, forest 35 %
Soils: sandy or organic and wetlands
Difference in altitude: 178 m

Intermediate scale: Nuthe

Area: 1803 km²
Land use: agriculture 39 %, forest 33 %
Soils: sandy or organic and wetlands
Difference in altitude: 143 m

Focus scale: Hammerfließ

Area: 211 km²
Land use: forest 48 %, agriculture 42 %
Soils: sandy or organic and wetlands
Difference in altitude: 131 m

Objectives and scheduled work

The main objective of the subproject is the development of methods to reduce nitrogen and phosphorus emissions from agriculture. Based on different scenarios of land use change the nutrient transport from diffuse sources shall be simulated. Therefore, the validation of the ecohydrological model SWIM is necessary with a focus on hydrological processes as well as nitrogen and phosphorus fluxes.

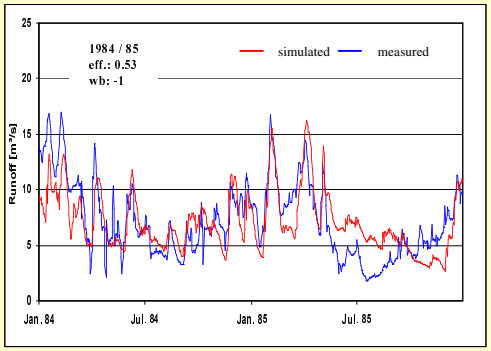

Figure 2: Daily water discharge 1984 / 85

Hydrological validation is a prerequisite for water quality modelling. The results for the Nuthe basin agree with the measured data considering the regional hydrological conditions like the influence of drainage and ground water (Fig. 2, 3).

Total time period:
1981-1987
Efficiency (Nash/Sutcliff):
0.51
Water balance:
-5%

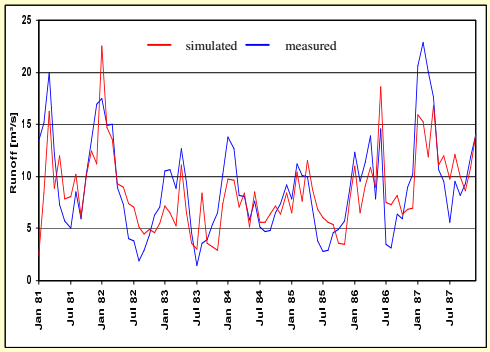

Figure 3: Monthly water discharge 1981 - 1987

Figures 4 and 5 represent the first results of the **nitrate simulation** in the Nuthe basin. Base for this modelling is the SWIM nitrogen module shown in figure 6. Next steps for the future are the implementation of ammonium into the SWIM nitrogen module and the validation of the SWIM phosphorus module.

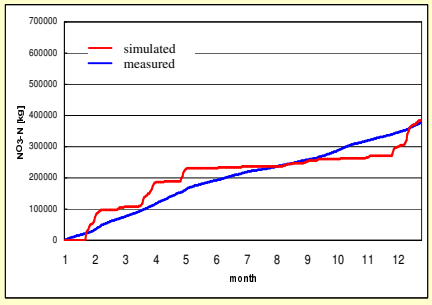

Figure 4: Accumulated annual nitrate load 1985

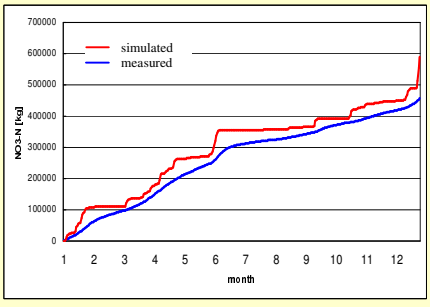

Figure 5: Accumulated annual nitrate load 1986

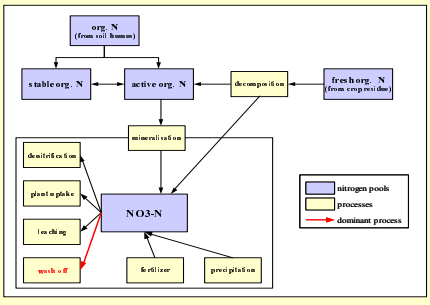

Figure 6: SWIM nitrogen module

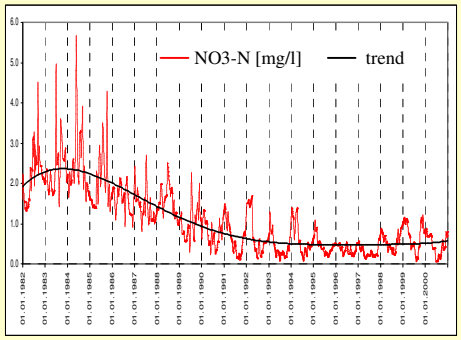

Figure 7: Measured nitrate concentration 1982 - 2001

The **analysis of measured data** shows an obvious trend in nitrat fluxes between 1982 and 2001 (Fig. 7). Reasons for this are mainly changes in land use management as well as in the fertilisation regime.

1982 - 1991	
Min:	0.09
Max:	5.67
Ave:	1.62
1992 - 2001	
Min:	0.05
Max:	1.70
Ave:	0.53

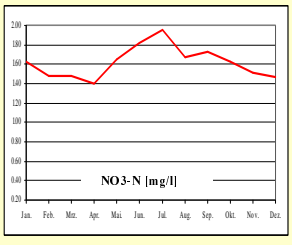

Figure 8: Monthly longterm average 1982 - 1991

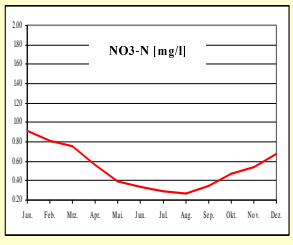

Figure 9: Monthly longterm average 1992 - 2001

Monthly longterm averages of nitrate concentration verify the trend (Fig. 8, 9).